Can Big/Agri Data Offer Insight To Crop Protection?

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Government of Saskatchewan

Outline

Introduction
- What is Big Data?
- Big/Agri Data Of A Farm

Production Agriculture
- Biology + Environment + Management

Crop Protection
- What is crop protection
- Big Data and crop protection
- Big/Weather Data and Fusarium Head Blight (FHB)

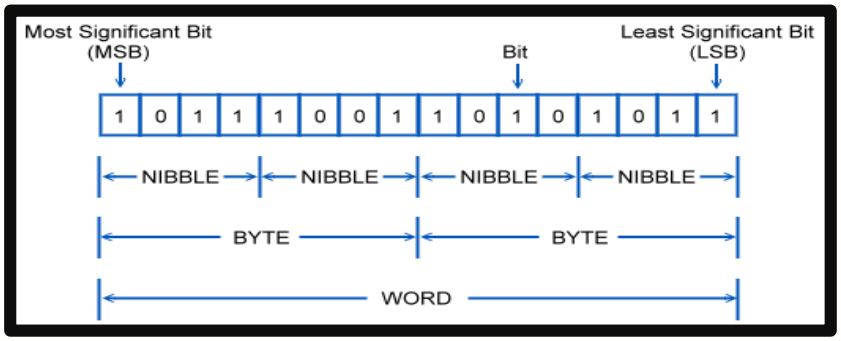
Data Management
- Data Collection, Integration and Support
- Technology: Hardware, Software and Smartphones
- Computational and inferential thinking
- Data Analytics and Insight
- Farmers and ATPs
- Data Ownership and Privacy
- Data Strategy: Awareness, Literacy

What is Big Data?

The coconut milk-drinking nerds in Silicon Valley say:
Everyday, the world generates 2.5 quintillion bytes of electronic data.

What is 2.5 quintillion?
Think two, comma, five and then 17 zeroes.
[2,500,000,000,000,000,000 bytes]

More than 57.5 billion iPads, each with a 32-gigabyte memory, will be needed to hold it. Then you need another 57.5 billion iPads to store tomorrow's data.....
You get the idea. Big data is really BIG!!



Big Data is everywhere
supermarket scanners, weather sensors, digital pictures, video,
and of course, **Ag data** also generate "Big Data."

[Source: Big Ag and Big Data, Farm & Food File, Dec 1, 2013]

What Is Data?

Stream of raw facts that occur in a physical environment (e.g. a farm) before those facts are organized and arranged into a form that people can understand and use.

“Some people see data as facts and figures. But it’s more than that. It’s the lifeblood of your business. It tells the history of your organization. And it’s trying to tell you something.”

SAS (pronounced "sass")
“Statistical Analysis System"

SAS Began at North Carolina State University as a project to analyze agricultural research. As demand for such software grew, SAS was founded in 1976 to help all sorts of customers – from pharmaceutical companies and banks to academic and governmental entities.

A Data R&D organization in Australia

"Data is the new currency of our world. Data-driven insights change the way we live, work, invent and innovate

Data is the raw material that fuels new industries and disrupts existing ones

We're shifting to a new economic structure, an evidence-based world, where data underpins our decision making."

CPA magazine, January 2017 says:

Big Data Equals Bigger Insights

Over the next few years, vast amounts of information from digital sources and sensors will give business decision-makers powerful predictive tools that will completely transform performance

Agri Data

- A modern combine - data every two seconds - **14,500 data points** per eight hours
- Sensors for harvest equipment can generate **several gigabytes** of data/acre.
- Sources of data: **Soil** (e.g. soil map), **Seeding** (e.g. seed depth, population density), **Emergence**, **Scouting**, **Feed efficiency** and **Genetic selection** in cattle, **Weather**, **Harvesting** , **Marketing**, etc.

- If farmers can utilize those sets of data, these could transform the **efficiency**, **productivity**, **profitability** and **competitiveness** of the farm.

Source: ***Getting Rich From Your Farm Data***
Country Guide, Feb, 2016

Estimated Amount Of Data Generated By The Average Farm Per Day

Source: OnFarm, BI Intelligence Estimates, 2015

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Progression of Farming

Lance Donny (Founder: OnFarm System Inc.) says: Progression of farming has three stages.

The first stage, preindustrial agriculture, from Christ to about 1920: labor-intensive, subsistence farming on small farms, **took two acres to feed one person**.

The Second stage, industrial agriculture, from 1920 to about 2010,

- tractors and combine harvesters,
- chemical fertilizers and seed science
- large commercial farms.
- Big gains in productivity,
- **One acre feeding five people.**

The Third stage, Mr. Donny calls it Ag 3.0, is just getting underway:

- **Use of data** from many sources — sensors on equipment, satellite images and weather
- Use of water and fertilizer may be monitored in detail, even plant-by-plant basis.
- Inexpensive sensors, cloud computing and intelligent software, hold the potential to transform agriculture and help feed the world's growing population

Data can reduce cost, optimize productivity, minimize environmental impact, provide a food traceability trend and can improve transparency on farming

BIG DATA

"You Can't Manage What You Don't Measure"

Pulses
Oilseeds
Cereals
Crops

Sustainability
Insects
Pathogens
Weeds
Pests
Biomes

Agronomy
- -weed control
- -seeding
- -spraying
- -harvesting

Farm Business
- - Cost of production
- - Risk management

Production Agriculture = **Biology** + **Environment** + **Management**

Genetics/Genomics
Breeding
Proteomics
Metabolomics
Phenomics

Soil/Nutrients
Temperature
Moisture
Rainfall
Weather
Hail

Technology
- - Hardware
- - Software
- - Mobiles
- - IoAgT

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Big Data is:

1. A tool/technology – Day 2
2. A renewable resource
3. A commodity
4. Information and knowledge - power

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- Using resistant varieties
- Using effective chemicals
- Crop rotation

Protection from abiotic stress

- Hail
- Drought, heat, cold, excess moisture

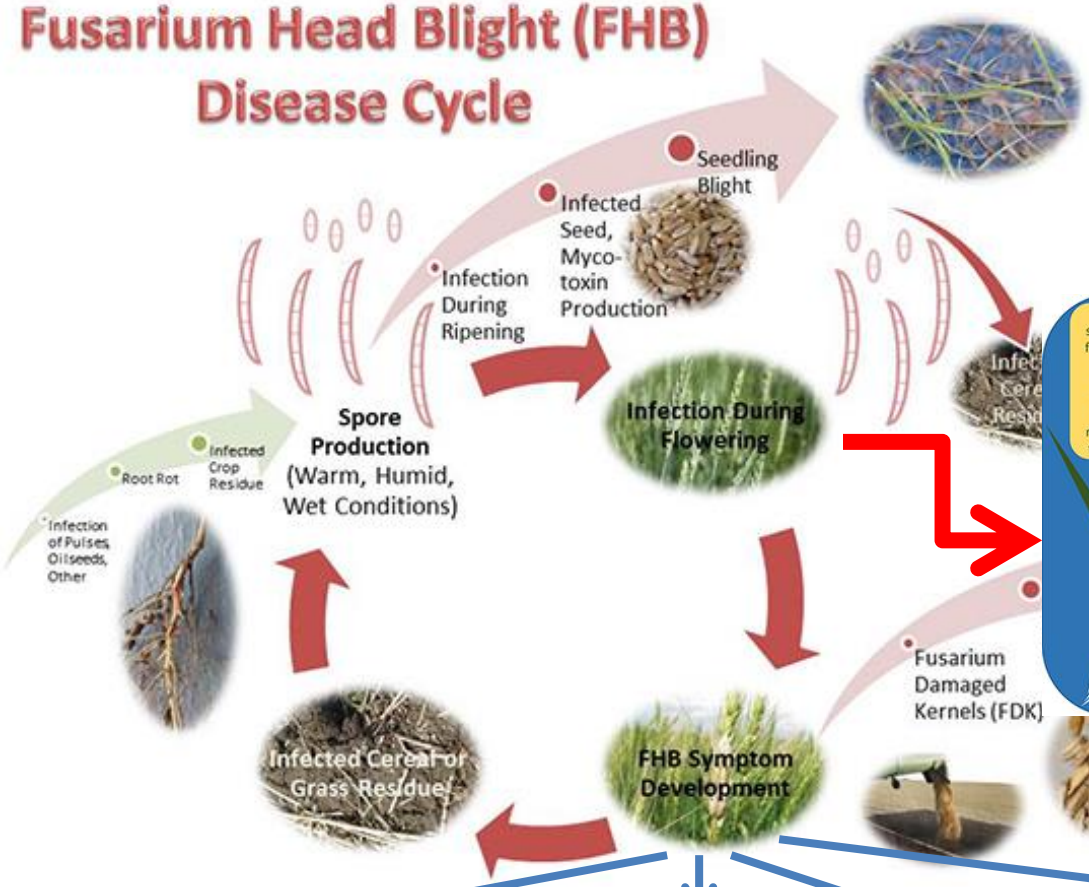
Protection from animals/humans

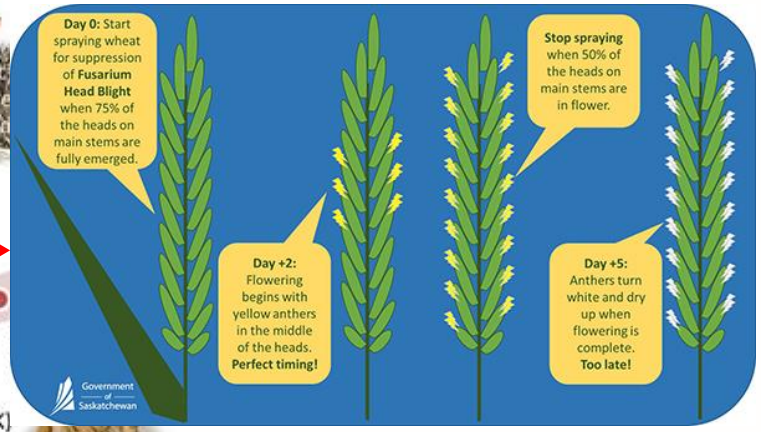
- Wild animals
- Neighbors

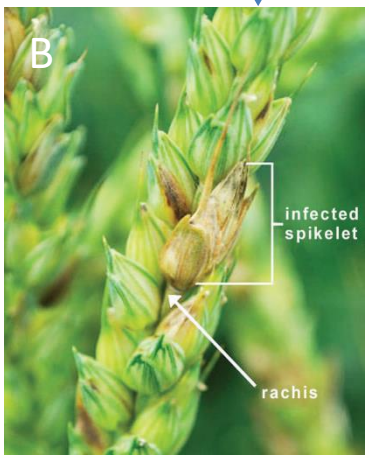
Durum and Wheat Protection from FHB

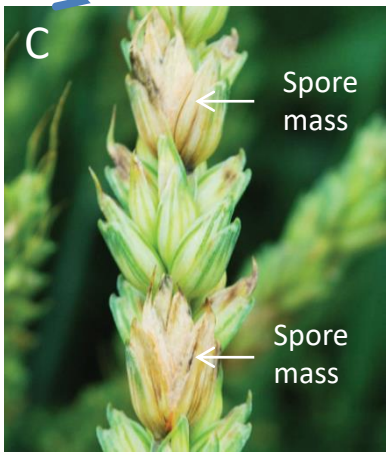
- Resistant varieties
- Effective chemicals
- Crop rotation
- **New tools – data, digital technology and weather map**

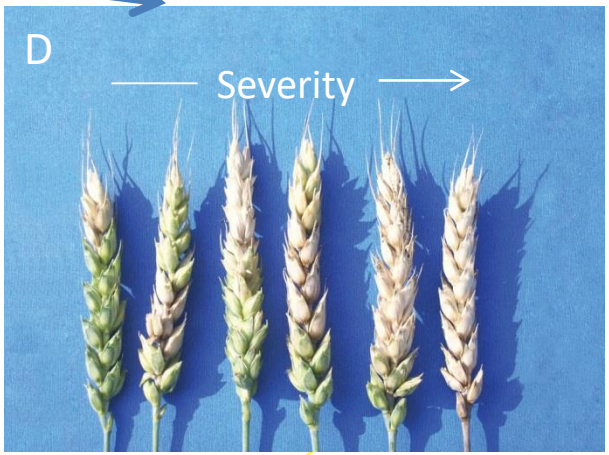
Fusarium Head Blight (FHB) Disease Cycle

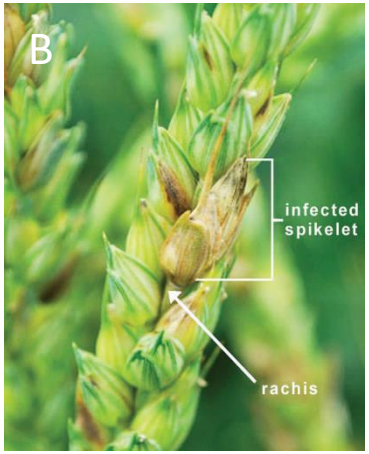


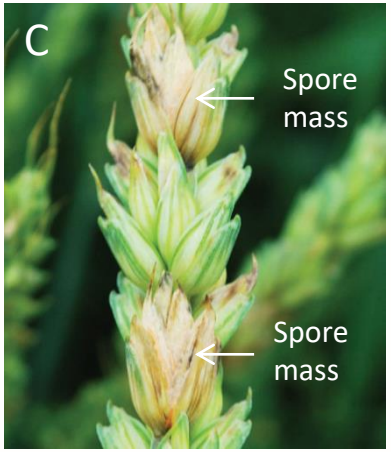


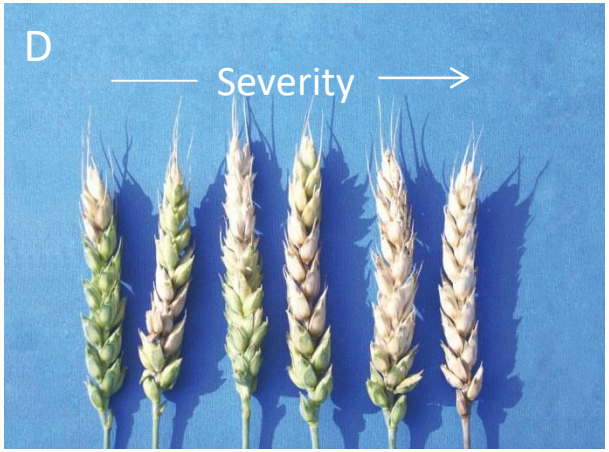


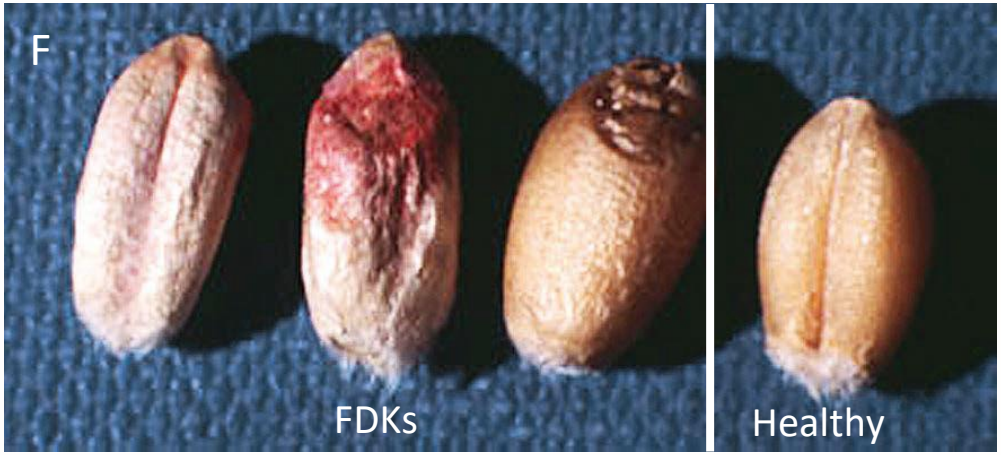












Symptoms: A. First symptom is some spikelets are bleaching while healthy ones are still green

B. As fungus moves into the rachis, spikelets above and below may also bleach

C. Pink/Orange spore masses accumulate (arrows) during wet and humid weather

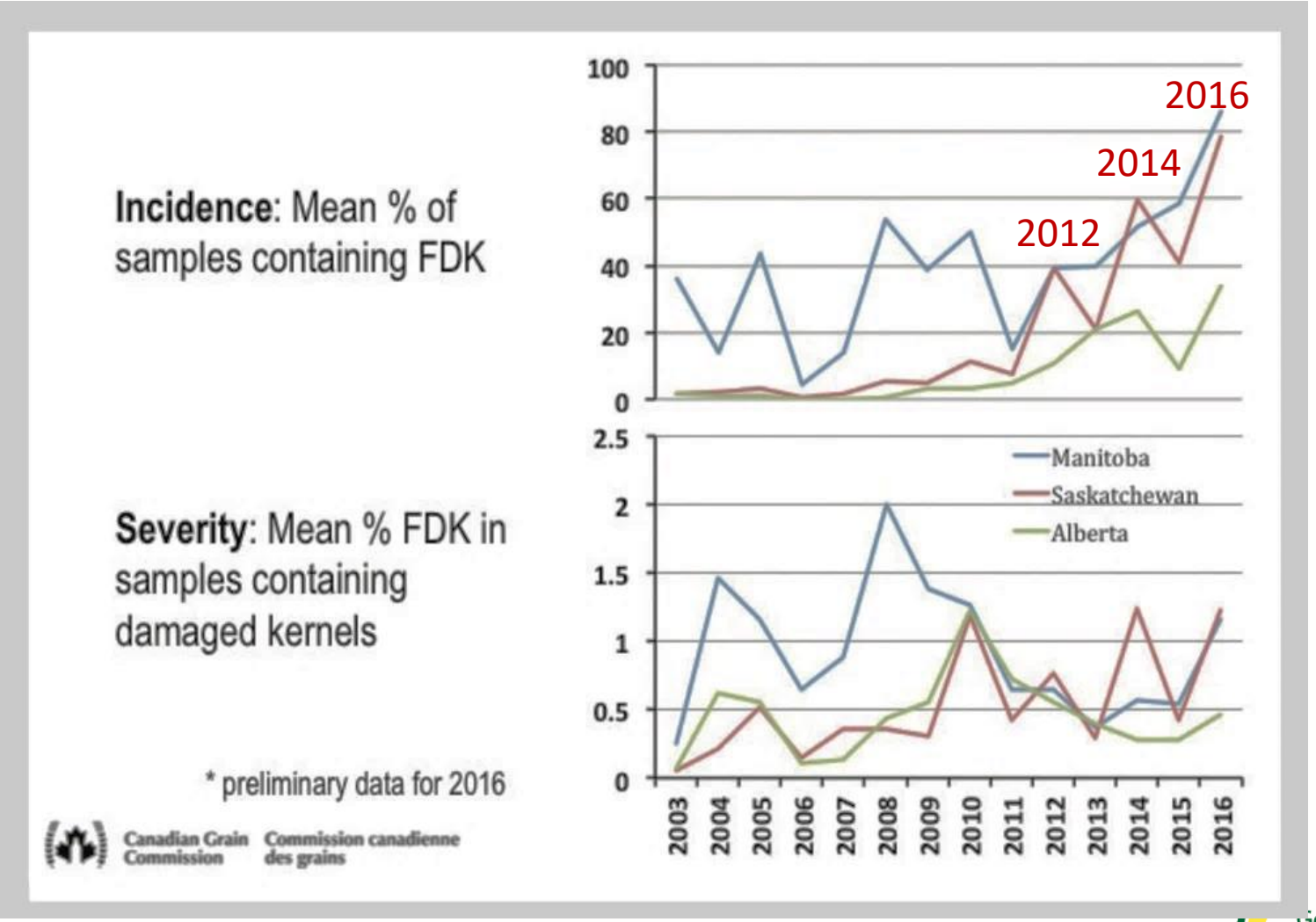
D. Disease progression along the length of the spikes (low to severe symptoms)

E. FHB infected field with **one severely infected spike outstanding** in the field

F. FDKs (left) and a healthy kernel (right)

[Source: APS and Grainews, 2014]

Fusarium Head Blight Incidence severity on the Prairies

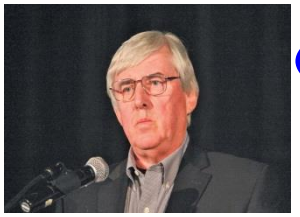


[Source: Canadian Grain Commission, 2016]

2016 FHB on Quality & Revenue Loss on the Prairies

[Source: Manitoba Co-Operator, Dec 2016]

- **>200 scientists - Canada, the United States, Germany, England, Australia, Switzerland and beyond** - reviewed latest research into FHB. Nov, 2016 in Ottawa.



Gordon Harrison, President, Canadian National Millers Association

- "The 2016 WC wheat harvest– **the worst on record for FHB damage and DON (deoxynivalenol, a mycotoxin) levels** in many crop districts,"
- "FHB damage is **1.5 to five times more** than experienced in recent years."
- "**A significant portion** of **Canada Western Amber durum (CWAD)** wheat harvest (used to make pasta) may **be unmarketable as milling grade**,"
- **No. 2 and 3 Canada Western Red Spring wheat (CWRS)** — Canada's top bread-making wheat — also has **high levels of DON**, he said.
- Downgrading could **cost Prairie farmers $1 billion in lost revenue**, Harrison estimated.

Crop Protection

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Protection from abiotic stress

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Durum and Wheat protection from FHB

- Resistant varieties
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- **New tools – data, digital technology and weather map**

Use of single management strategies not adequate when env. is favorable For disease pressure...

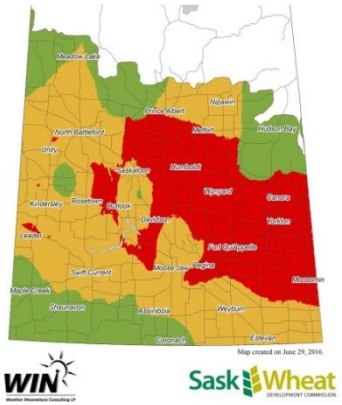
2016 Fusarium Head Blight Risk Map

Spring Wheat, 2016 (June – July)

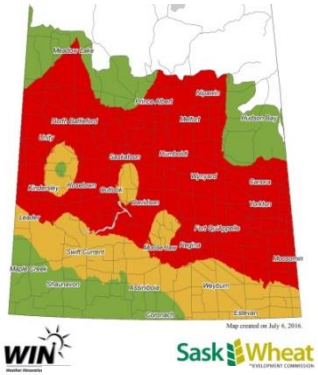
Low Medium High

JUNE 12/16

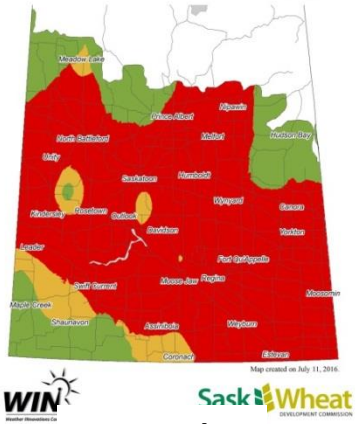
JUNE 23/16



JUNE 29/16



JULY 06/16



JULY 11/16

Source: SaskWheat, 2016

Data Supported FHB Management

- High Density weather coverage

Farmers Edge

- FHB hours:

U.S. Wheat Barley Scab Initiative (USWBSI)
Farmers Initiative of data use for FHB management

- Genomics, phenotyping – Data

Quantitative characters, QTL, Genomics

Fusariurm Head Blight (FHB) R&D, Agronomy and Extension

Academia, Industry and Government

Pierre J. Hucl

Curtis J. Pozniak,

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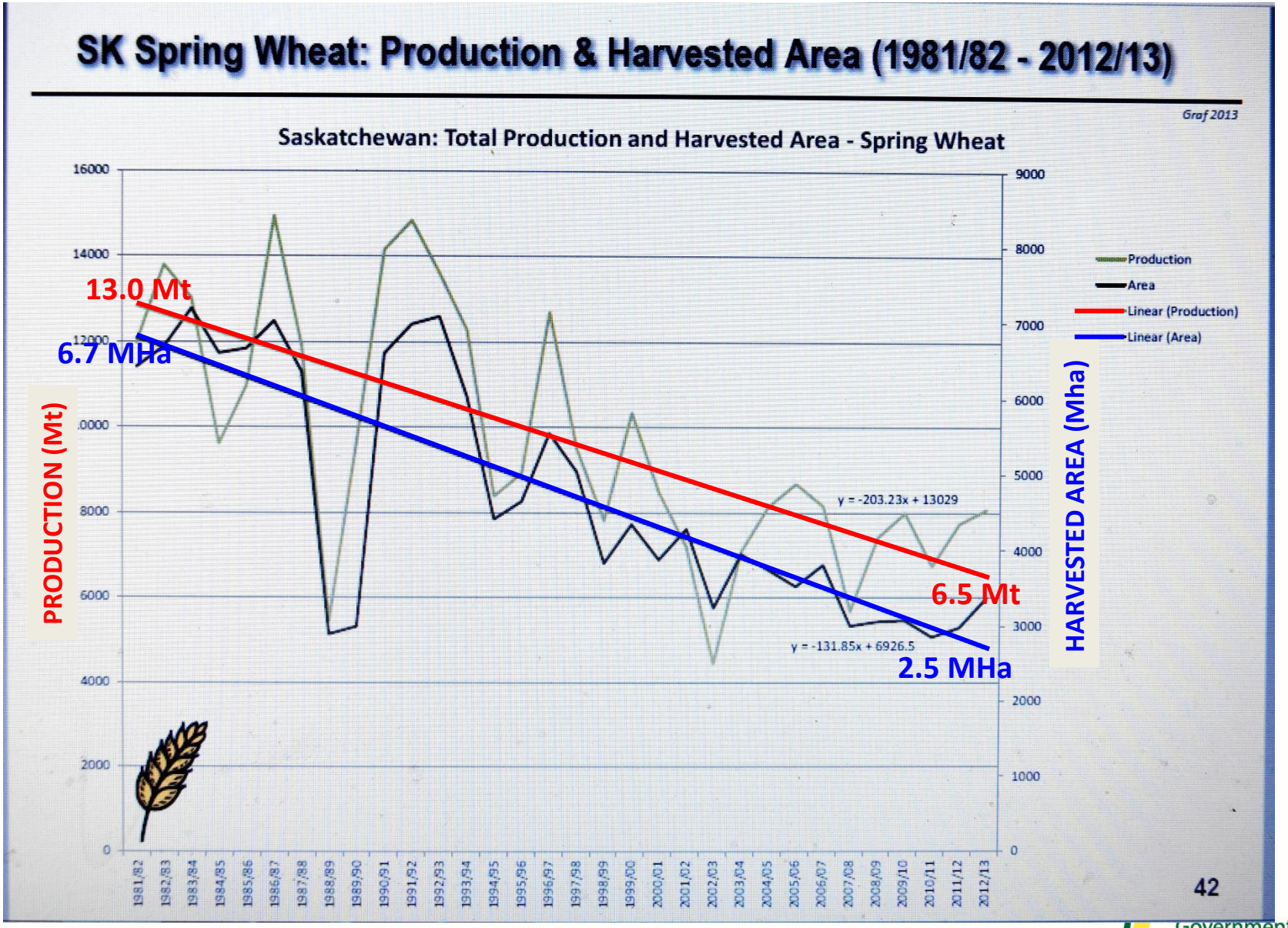
Barbara Ziesman, Provincial Specialist, Plant Disease
Ministry of Agriculture, Government of Saskatchewan

R&D and Agronomy Services By the Industry

e.g.
SaskWheat
BAYER Crop Science

SK Spring Wheat: Production & Harvested Area (1981/82 - 2012/13)



1981/82

2012/13

[Source: Graf, 2013]

SK Photo: Shankar Das